

10 is claimed is:

1. A retaining wall system comprising:  
confined face layers forming a mechanically stabilized earthen wall  
fill;  
an assembly of rigid, full height fascia panels;  
15 a separate foundation to support said fascia panels;  
adjustable attachment points connected to said fascia panels for  
horizontal and plumb adjustment of said fascia panels;  
synthetic deformed bars (sdb's) attached to said fascia panels at  
said attachment points for anchoring said fascia panels to said  
20 mechanically earthen fill;  
a void separating said fascia panels from said mechanically  
stabilized earthen wall fill; and  
a layer of fill at the top of said void.
2. The system of claim 1, wherein a plurality of said sdb's are U-  
25 shaped, each end of said U-shaped sdb's adapted for attachment to said  
fascia panels at said attachment points.
3. The system of claim 2, wherein said U-shaped sdb's are  
generally horizontally disposed in said mechanically stabilized earthen  
wall fill.
- 30 4. The system of claim 3, further comprising generally vertically  
disposed sdb's connected to said U shaped synthetic deformed bars.
5. The system of claim 4, wherein a pair of said generally  
vertically disposed sdb's are placed at the proximity of each opposing  
corner of said U-shaped sdb's.

6. The system of claim 2, wherein said generally horizontal sdb's are disposed in layers in said mechanically stabilized earthen wall fill, said layers including a lower layer and an upper layer.

7. The system of claim 6, wherein generally vertically oriented sdb's are extended in a substantially vertical plane above said layer of U-shaped sdb's.

8. The system of claim 2 wherein said generally horizontal disposed U-shaped bars further comprise a U bend shape, said U bend shape placed within the confines of said mechanically stabilized earthen wall fill.

9. The system of claim 1, wherein said sdb's are U-shaped or U shaped with a U bend shape, said sdb's optionally having a reduced length placed within a geosynthetic sheet or geosynthetic grid soil reinforcement.

10. The system of claim 1, wherein said sdb ends are adapted for attachment to said fascia panels.

11. The system of claim 1, wherein said sdb's with said end adaptations extend from said confined face layers for attachment to said fascia panels.

12. A retaining wall system comprising:

a mechanically stabilized earthen backfill (MSE) having a base, intermediate layers, and an uppermost layer;

an assembly of full height rigid fascia panels, each of said fascia panel having a lower edge;

a separate foundation to support said fascia panels, said foundation having an attachment point for receiving said fascia panel lower edges;

synthetic deformed bars (sdb's) embedded in said MSE;

said sdb's attached to said fascia panels;

adjustment mechanisms connecting said fascia panels to said sdb's and providing horizontal alignment of said fascia panels;

sdb connections to said full height fascia panels that allow limited vertical relative movement between said fascia panels and said MSE; and

a void separating said fascia panels from said MSE.

13. The system of claim 12, wherein said fascia panels further comprise:

precast concrete fascia panels having prepositioned adjustable attachment points cast into said fascia panels during manufacture.

14. The system of claim 12, wherein said sdb's are U-shaped.

15. The system of claim 14, wherein said U-shaped sdb's are set in horizontal layers in said MSE.

16. The system of claim 14, wherein vertically disposed sdb's are supported by a U portion of said U-shaped sdb's.

17. The system of claim 16, wherein said U-shaped sdb's, said vertically disposed sdb's and a flexible material to form confined fill layers of said mechanically stabilized earthen wall fill.

18. The system of claim 12, further comprising void end connectors connected to said sdb's.

19. The system of claim 14, wherein a U portion of void end connector sdb's is within said MSE.

20. The system of claim 12, wherein said void end connector sdb's, a plurality of vertically disposed rigid bars and a flexible material form said confined fill layers of mechanically stabilized earthen wall fill.

21. A method of constructing a retaining wall comprising:

forming a mechanically stabilized earthen wall fill having confined layers;

constructing a separate foundation to support an assembly of full height rigid fascia panels, said fascia panels having a face side;

embedding synthetic deformed bar (sdb) assemblies between designated layers of said mechanically stabilized earthen wall fill;

connecting said fascia panels to said sdb assemblies;

aligning said fascia panels using adjustable panel connection mechanisms that allow horizontal and plumb alignment of said fascia panels; and

providing a void between said fascia panels and said mechanically stabilized earthen wall fill.

22. A retaining wall facing system comprising:

an elevated, remote foundation;

an mechanically stabilized earthen backfill (MSE) having a base, intermediate layers, and an uppermost layer;

an assembly of full height rigid fascia panels, each of said fascia panel having a lower edge;

5 a separate foundation to support said fascia panels, said foundation having an attachment point for receiving said fascia panel lower edges;

synthetic deformed bar (sdb) anchors embedded in said MSE;

adjustment mechanisms connecting said anchors attached to said  
10 fascia panels and allowing horizontal and plumb adjustment of said fascia panels;

sdb anchor connections connecting said full height fascia panels to said anchors, said sdb anchor connections allowing limited vertical relative movement between said fascia panels and said MSE; and

15 a void separating said fascia panels from said MSE.

23. The system of claim 22, wherein said facing panels are:

precast concrete facing panels having prepositioned adjustable attachment points cast into said facing panels during manufacture, said sdb anchor connections connected to said fascia panels at said  
20 adjustable attachment points.

24. The system of claim 22, wherein said foundation comprises:

a continuous foundation beam to which said facing panels are mechanically attached.

25. The system of claim 22, wherein said foundation comprises:

25 separate foundation beams positioned at a vertical joint of adjacent panels, said panels mechanically attached to said foundation beams.

26. The system of claim 22, wherein said generally horizontally disposed sdb's have a semicircular shape at said confined face layers.

30 27. The system of claim 22, wherein said semicircular sdb's restrain longitudinally corrugated sheets placed between adjacent vertically separated said semicircular sdb's.

28. The system of claim 27, wherein the separate MSE wall fill utilizes steel deformed bars as semicircular soil reinforcement for use  
35 as a temporary MSE wall wherein panels are optionally attached.

29. The retaining wall system comprising:  
generally horizontally disposed layers of sdb tensile inclusion  
members forming a mechanically stabilized earthen wall fill;

an assembly of rigid full height facing panel;

5 adjustable attachment points connected to said full height facing  
panels for a vertical and plumb adjustment of said panels, allowing for  
relative vertical movement;

a portion or all of said sdb tensile inclusion members attached to  
said full height panels;

10 an optional partial void separating said fascia panel from a  
partial said sdb stabilized closed face earthen wall fill; and

a foundation beam supporting said full height wall facing panels.

30. The wall system as claimed in claim 29, wherein a separate  
closed face sdb MSE wall is constructed to partial overall wall height.

15 31. The wall system as claimed in claim 29, wherein a number of  
said sdb tensile inclusion members within said separate closed face sdb  
MSE wall extend to the backside of said full height facing panel.

20 32. The wall system as claimed in claim 29, wherein said full  
height facing panel is attached to said extending sdb's from said closed  
faced sdb.

33. The wall system as claimed in claim 29, wherein all or a  
portion of said sdb's used for tensile inclusion members for said sdb  
MSE wall above the top of said partial closed face sdb MSE wall are  
attached to the full height wall facing panel.

25 34. The wall system as claimed in claim 29, wherein all or a  
portion of said sdb tensile inclusion members are attached to said full  
height wall panel.

30 35. The wall system as claimed in claim 29, wherein attachment  
points of said sdb's to said facing panel allow for horizontal and plumb  
alignment of said facing panel.

36. The wall system as claimed in claim 29, wherein said  
attachment points of said sdb's to said facing panel allow for vertical  
relative movement between said wall panel and said sdb tensile inclusion  
member.

37. The wall system as claimed in claim 31, wherein said sdb's are either straight or U-shaped.

38. A multipanel retaining wall system, comprising:

a mechanically stabilized earth backfill (MSE);

5 a separate foundation;

wall facing comprising an assembly of shaped perimeter and area facing panels, each panel having a top edge, a bottom edge, a front side, a back side, and attachment points on said panel back side, said attachment points optionally providing vertical and horizontally  
10 adjustable of said facing panels; and

a generally horizontal, layered array of synthetic deformed bars (sdb's) disposed in said MSE; said sdb's attached to said attachment points.

39. The system of claim 38, wherein said facing panels are located  
15 within said wall face with adjacent edges of said panel placed to correspond to the same shape edges of each adjoining panel.

40. The system of claim 38, wherein said foundation comprises:  
a continuous foundation beam.

41. The wall system as claimed in claim 38, wherein said  
20 attachment points of said sdb's to said facing panel allow for vertical relative movement between said wall panel and said sdb tensile inclusion member.

42. The system of claim 38, wherein said wall facing comprises panels located within said exposed wall face with vertically disposed  
25 adjacent edges of each panel placed to correspond to the same shape edge of each adjoining panel and each horizontal edge of adjacent panel are horizontally disposed from each adjacent panel.

43. A method of constructing a retaining wall comprising:

constructing a foundation to support an assembly of multiple wall  
30 facing panels, said panels having mating adjoining sides of any suitable shape;

connecting rigid synthetic deformed bars (sdb's) to said wall facing panels;

placing fill behind said wall facing panels; and

embedding said sdb's within said fill to form a mechanically stabilized reinforced earth backfill (MSE); and

wherein said MSE is formed without a requirement for bracing of said wall panels.

5        44. The method of claim 1,12,21,22 and 43 wherein said sdb's are U-shaped sdb's, straight sdb's or a combination thereof.

45. The wall system as claimed in claim 1,12,21,22,29,43 wherein said sdb's are placed jointly within said MSE wall with other flexible geosynthetic fabric or geogrid optional soil reinforcement layers.

10       46. The wall system as claimed in claim 38, wherein said sdb is a void connector.

47. The wall system as claimed in claim 38, wherein said facing panel includes parallel vertically offset straps, said straps U-shaped, said straps protruding from backside of said panel.

15       48. The wall system as claimed in claim 38, wherein a vertical pin sized of diameter smaller than said void connector diameter with length equal to horizontal displacement of said U-shaped straps.

49. The wall system as claimed in claim 38, wherein said void end connector is placed on suitable elastomeric compressible material such  
20 as closed cell foam or similar material.

50. The wall system as claimed in claim 38, wherein a recess void is provided in the backside of said panel.

51. The wall system as claimed in claim 38, wherein a vertical pin is provided within the uppermost portion of said vertical pin is  
25 displaced from top of said recess void.

52. The wall system as claimed in claim 38, wherein said suitable elastomeric compressible material supports said void end connector placed onto said vertical pin.

53. The wall system as claimed in claim 38, wherein the said  
30 recess in the backside of said panel has a partially closed face.

54. The wall system as claimed in claim 38, wherein the said partially closed face is a vertically slotted channel.

55. The wall system as claimed in claim 38, wherein the slot width in said vertically slotted channel is slightly greater than the  
35 diameter of a threaded end extension sdb.

56. The wall system as claimed in claim 38, wherein a spacer of slightly wider width than the thickness of said channel with a slightly smaller diameter than the opening of said slot placed within said slot.

5 57. The wall system as claimed in claim 38, wherein said threaded end extension sdb is secured to said slotted channel within slot with nuts threaded onto said threaded extension sdb on each side of said slotted channel.

10 58. The wall system as claimed in claim 38, wherein said threaded end extension sdb is attached to said slotted channel with a single nut threaded onto said threaded extension end sdb within said slotted channel.

59. The wall system as claimed in claim 38, wherein said elastomeric, compressible material is placed within said recess void.

15 60. The wall system as claimed in claim 38, wherein a threaded insert attachment point is provided in the backside of said panel.

61. The wall system as claimed in claim 38, wherein said threaded end extension sdb is threaded into said threaded insert.

62. A retaining wall facing system comprising:

20 mechanically stabilized earthen (MSE) backfill having a base, intermediate layers, and an uppermost layer;  
an assembly of tier layer height rigid facing panels;  
synthetic deformed bars (sdb') anchors embedded in said MSE;  
attachment devices connected to said anchors to support  
25 horizontally disposed rigid bars spanning between adjacent said sdb's in each said MSE layer;  
said rigid tier layer height facing panels placed edge to edge forming generally horizontally disposed rows;  
said adjacent vertically stacked rows horizontally displaced.

30 63. The system of claim 62, wherein said generally horizontally disposed rigid sdb's, corrosion resistant steel, aluminum, or synthetic material bars span between adjacent void end connector sdb's.

35 64. The system of claim 62, wherein precast roofing ballast panels, or precast roof tiles, or other cementitious roof tiles are



placed behind said horizontally disposed bars in an essentially vertically disposed plane to retain earth fill adjacent said pavers or tiles.

5        65. The system of claim 62, wherein the said planar assembly of said pavers or tiles leans outward with a reverse batter.

66. The system of claim 62, wherein subsequent paired horizontally disposed layers of void end sdb arrays and planar rows of said pavers or tiles are horizontally offset from said adjacent planar rows.

10       67. The system of claim 62, wherein steel or aluminum welded wire fabric combined with geotextile sheets are placed behind said horizontally disposed bars in an essentially vertically disposed plane to retain earth fill adjacent to said welded wire fabric and said geotextile sheet.

15       68. The system of claim 62, wherein said planar combination of said welded wire fabric and geotextiles is oriented with a reverse batter.

20       69. The system of claim 62, wherein said subsequent paired horizontally disposed layers of said void end sdb arrays and said planar rows of said welded wire fabric geotextile faces are horizontally offset from said adjacent planar rows.

70. A generally vertically disposed precast retaining wall system, said retaining wall system comprising:

25       an assembly of wall panels attached to similarly shaped concrete foundation tees side by side with each wall panel, including either a single or a pair of generally T-shaped vertical stems formed with a horizontal and optionally with a vertical bearing surface;

shaped vertical tee stems formed with a horizontal and optionally with a vertical bearing surface for contact with the horizontal bearing surfaces of the foundation tee stems;

30       precast concrete tee stems forming a foundation means for supporting said retaining wall system, each tee including either a single or a pair of generally T-shaped vertical tee stems formed with a horizontal bearing surface;

shaped vertical tee stems formed with a horizontal and optionally with a vertical bearing surface for contact with corresponding vertical and horizontal bearing surfaces of said foundation tee stems;

5 said foundation tees having sufficient bending moment capacity to resist overturning loads of said wall panels;

generally vertically disposed synthetic deformed bar tension rods (sdb's) within said wall panels attached to voids in said base tee stems.

10 71. The wall system of claim 70, wherein said precast concrete foundation tee stems include a single or a pair of generally T-shaped vertical tee stems formed with a horizontal and optional vertical bearing surface.

15 72. The wall system of claim 70, wherein said sdb's protruding from said wall panel stem are secured to encapsulate said sdb's in the void of said precast foundation tee.

73. The wall system of claim 70, wherein said sdb's are attached to said foundation tees prior to placement of said wall tees.

74. The wall system of claim 70, wherein said tee wall panels are connected to said foundation tees with vertically protruding sdb's.

20 75. The wall system of claim 70, wherein said wall tee members have generally vertically disposed voids and tensioning plates included in said wall tee stems.

25 76. The wall system of claim 70, wherein said foundation tees and said wall tees are attached with threaded end extension sdb's in said void in said wall stems.

77. The wall system as claimed in claim 70, wherein said horizontal bearing surface between said wall tee and said foundation tee allows for shimming and grouting for alignment and bearing between said wall and said foundation tee.

30 78. The wall system of claim 70, wherein threaded extension sdb's are threaded into couplers in said foundation tee stem through said wall stem void.

79. The wall system of claim 70, wherein said threaded extension sdb's are secured at an uppermost portion of said wall stem.

80. The wall system of claim 70, wherein said threaded extension sdb's within said void in said wall stem and in said foundation stem are encapsulated.

81. The wall system of claim 70, wherein high strength steel  
5 threadbars are threaded into couplers in said foundation tee stem through said wall stem void.

82. The wall system of claim 70, wherein said high strength steel threadbars are tensioned and secured at an uppermost portion of said wall stem.

10 83. The wall system of claim 70, wherein said high strength steel threadbars within said void in said wall stem and in said foundation stem are encapsulated.

84. The wall system of claim 70, wherein high strength steel strand cables are inserted in said void in said wall stem and in said  
15 void in said foundation tee stem.

85. The wall system of claim 70, wherein said high strength steel strand cable is attached to strand couplers at said foundation stem.

86. The wall system of claim 70, wherein said high strength steel strand cables within said void in said wall stem and in said foundation  
20 stem are encapsulated.

87. The wall system of claim 70, wherein said wall tees are free standing following placement of thread extension sdb's, high strength steel thread bars or high strength steel cables connecting said wall tees to said foundation tees.

25 88. The wall system of claim 70, wherein said attachment point of said wall tee stems to said foundation tee stem varies over the length of said foundation tee.

89. The wall system of claim 70, wherein a cast-in-place concrete shear key is optionally placed in front of said foundation tees.

30 90. The wall system of claim 70, wherein said shear key is attached to said foundation tee with sdb's or steel deformed bars or steel thread bars to said foundation tee.

91. The wall system of claim 70, wherein adjacent foundation tee/wall tee assemblies are attached by either sdb's, threaded extension

sdb's, high strength steel threadbars, or high strength steel strand cables horizontally displaced from each other.

92. The wall system of claim 70, wherein said wall tees faces are utilized to support generally horizontally disposed trapezoidal shaped precast concrete panels spanning between adjacent horizontally displaced wall tees.

93. The wall system of claim 70, wherein said wall tees are attached to generally horizontal threaded extension end sdb's, void end sdb's, or high strength threadbars.

94. The wall system of claim 70, wherein said threaded end extension sdb's , void end sdb's, or high strength steel threadbars are attached to said stems of said wall tees.

95. The wall system of claim 70, wherein horizontally disposed threaded extension end sdb, void end sdb, or high strength threadbars are attached to deadmen placed in excavated trenches or slots within in situ material behind said tee wall assemblies.

96. The wall system of claim 70, wherein said deadmen are plates attached to horizontally disposed threaded extension end sdb's, void end sdb's, or high strength threadbars placed in trenches in insitu material excavated behind said wall tees.

97. The wall system of claim 70, wherein said plates are encapsulated in concrete.

98. The wall system of claim 70, wherein said deadmen are encapsulated in concrete slurry or other self-compacting fill.

99. The wall system as claimed in 70, wherein said foundation tee base is trapezoidal shaped.

100. The wall system as claimed in 70, wherein said foundation tee base shape facilitates plumb orientation of said vertically disposed tee wall panel.

101. The wall system as claimed in claim 70, wherein said foundation tee extends between two parallel opposing face wall tees.

102. The wall system as claimed in claim 70, wherein said opposing wall panels are attached to said extended foundation tee.

103. The wall system as claimed in claim 70, wherein said opposing wall panels are attached to opposing ends of said foundation tee at the

proximity of each end of said foundation tee.

104. The wall system as claimed in claim 70, wherein said foundation tee stems are perpendicular to said opposing faces of said wall tees.

5 105. The wall system as claimed in claim 70, wherein said wall tees are attached to said foundation tee with sdb's, steel thread bar, or steel cable strand.

106. The wall system as claimed in 70, wherein said opposing wall panel has additional said vertically disposed stem voids for additional  
10 said tensionable bars

107. The wall system as claimed in 70, wherein an upper panel is attached to both said lower opposing wall panel and to said extension tee foundation.

108. The wall system as claimed in 70, wherein both said lower and  
15 said upper wall panels are attached to said extended tee foundation with sdb's, steel thread bar, or steel cable strand inserted through said aligned vertically disposed stem voids.

109. A segmental, anchored, generally vertically inclined or variably inclined precast retaining wall system, said retaining wall  
20 system comprising:

foundation means for supporting said retaining wall system;

an assembly of base wall panels attached to said foundation each base panel including either a single or a pair of generally T-shaped vertical tee stems formed with a horizontal and vertical bearing  
25 surface;

shaped vertical tee stems formed with a horizontal and vertical bearing surface;

an assembly of upper subsequent tiers of wall panels stacked on said base tier panels, each upper tier panel including a single or pair  
30 of generally T-shaped vertical tee stems, formed with a horizontal and vertical bearing surface for contact with said horizontal and vertical bearing surfaces of the base wall panel tee stems;

straight or U-shaped sdb's attached to said base wall panels and to said upper tier wall panels said sdb's imbedded within geosynthetic or  
35 geogrid reinforced MSE wall;

base and upper flat wall panels placed between base and upper wall support panels; and

a horizontal displacement of exposed fill material between said base and upper wall support panels and flat wall panels.

5        110. The wall system as claimed in claim 109, wherein said foundation means comprises cast-in-place concrete foundation pads.

111. The wall system of claim 109, wherein said base support panel has a variable angle bottom stem.

10        112. The wall system of claim 109, wherein said base support panel is oriented on said foundation with a variable incline corresponding to said variable stem angle.

113. The wall system of claim 109, wherein said base support panels are attached to generally horizontally disposed sdb's.

15        114. The wall system of claim 109, wherein said horizontally displaced sdb's are placed within said mechanically stabilized earth wall utilizing geosynthetic sheets or other acceptable tensile inclusion members within said wall backfill material.

115. The method of claim 109, wherein said sdb's are U-shaped sdb's, straight sdb's or a combination thereof.

20        116. The wall system of claim 109, wherein flat trapezoidal shaped panels are placed between said base support panel.

117. The wall system as claimed in claim 109, wherein said foundation tee extends between two parallel opposing face wall tees.

25        118. The wall system as claimed in claim 109, wherein said foundation tee stems are perpendicular to said opposing faces of said wall tees.

119. An assembly of generally vertically and horizontally disposed structural precast concrete assembly comprising:

30        an assembly of similarly shaped concrete foundation tee formed side by side with each concrete foundation including either a single or pair of generally T-shaped stems formed with a horizontal and vertical bearing surface for contact with and attached to similarly shaped concrete pane;

35        precast concrete tee stems and flange forming a foundation or base for supporting a similarly shaped generally vertically disposed precast

concrete support tee;

shaped vertical tee stems formed with a horizontal and vertical bearing surface for contact with corresponding vertical and horizontal bearing surfaces of the foundation of base tee stems;

5        precast concrete tees forming a foundation or base means for supporting earth loaded panels placed between and bearing on said vertical tees for retaining wall or earth loaded structures;

120. A retaining wall system comprising:

10        an assembly of wall panels attached to similarly shaped concrete foundation tees;

including either a single or a pair of generally T-shaped vertical stems formed with a vertical bearing surface;

15        shaped vertical tee stems formed with a vertical bearing surface for contact with a corresponding vertical bearing surface of the foundation tee stems;

precast concrete tee stems forming a foundation means for supporting said vertical wall tee panels, each tee including either a single or pair of generally T-shaped vertical tee stems formed with a vertical bearing surface;

20        shaped vertical tee stems formed with a vertical bearing surface for contact with corresponding vertical bearing surfaces of said foundation tee stems;

generally horizontally disposed, trapezoidal panels spanning between adjacent, displaced said tee panel assemblies;

25        said wall tees having sufficient bending moment capacity to resist horizontal earth load imposed by said trapezoidal panels;

said foundation tees having sufficient bending moment capacity to assist overturning load imposed by said vertical wall tee;

30        generally horizontally disposed sdb's, steel threadbars, or high strength steel cable strands within said walls attached to voids in said foundation and said wall tees.

121. The wall system as claimed in claim 120, wherein the said foundation and wall tee members are attached by sdb's, threaded extension end sdb's, high strength threadbar, or other high strength  
35        steel cable strand, which are horizontally disposed.

122. The wall system as claimed in claim 120, wherein the said sdb's, threaded extension sdb's, steel threadbar or steel cable strands are tensioned and encapsulated in cementitious grout to structurally connect said foundation and vertical support wall tee.

5 123 . The wall system as claimed in claim 120, wherein the said foundation tee flange is in line with or elevated with respect to the lower edge of the said vertical support tee.

124. The wall system as claimed in claim 120, wherein the said vertically disposed wall support tee is inclined away from a vertical  
10 orientation.

125. The wall system as claimed in claim 120, wherein the said earth loaded panels alternatively bear on the said vertically disposed wall tee flange or back of the said wall tee stem.

126. The stabilized earth structure of Provisional Patent No.  
15 60/184,049, wherein the attachment devices are steel deformed bars or thread bars attached to a steel face plate.

127. The stabilized earth structure of Provisional Patent No.  
60/184,049, wherein the attachment of deformed steel bars or high  
strength steel cable strand U-shaped bars is by encapsulation in grout  
20 forming a structural bond to said sdb's placed in said insitu material in said drilled shaft.



Parts List (excluding parts as stated in PCT/US01/05733 and U.S.provisional pate application Number 60/184,409 applications)

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